Swami Ramanand Teerth Marathwada University, Nanded,
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Tentative Title of the thesis

"STUDIES ON FRESHWATER FISH SCALES-BIOFERTILIZER FROM NANDED CITY MAHARASHTRA"

Research Proposal Submitted
In Partial Fulfilment of Registration to

Doctor of Philosophy

In The Subject of **Zoology**
Faculty of Science and Technology

Submitted by

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Short Resume/ Synopsis of Ph.D. Topic

Studies on Freshwater Fish Scales - Biofertilizer from Nanded City Maharashtra.

ABSTRACT OF PROPOSED WORK PLAN/PROBLEM

Introduction:

Sustainable farming is essential for ensuring enough food for everyone and protecting the environment. A key part of sustainable farming is keeping the soil healthy, but soil health faces many problems. Over time, soil loses nutrients, becomes less fertile, and is often damaged by the heavy use of chemical fertilizers. To address these issues, there is a growing need for eco-friendly alternatives that are good for the soil and the environment.

One such option is biofertilizers, which are made from natural and organic materials. They consist of beneficial microorganisms, such as bacteria, fungi, and algae, that help improve soil health by enhancing nutrient availability. By improving nutrient cycling in the soil, biofertilizers ensure that plants receive the nutrients they need in a natural and efficient way. This natural process also helps maintain the soil's long-term fertility and quality.

One of the most significant advantages of biofertilizers is their ability to reduce the environmental impact of conventional farming practices. Unlike chemical fertilizers, which can contaminate groundwater, rivers, and other water bodies, biofertilizers do not cause pollution or soil degradation.

In addition to being environmentally friendly, biofertilizers are cost-effective for farmers. They are often less expensive than chemical fertilizers and have long-term benefits that help reduce overall farming costs. As they improve soil health over time, biofertilizers reduce the need for repeated fertilizer applications, which can be a significant financial burden for farmers.

Furthermore, biofertilizers can help increase crop yields by promoting stronger, healthier plants that are more resilient to stressors like drought, diseases, and pests. This makes them an essential tool for farmers who are looking to boost productivity while minimizing the negative impact on the environment. By supporting the growth of nutrient-rich, resilient crops and maintaining soil health, biofertilizers ensure that farming can continue to meet the needs of a growing population without compromising the health of the planet.

One promising but underused resource for making biofertilizers is freshwater fish scales, a common waste product from the fishing industry, have the potential to be turned into biofertilizers. These scales contain essential macronutrients, such as Collagen, Chitin, Fatty acids, Calcium (Ca), Phosphorus (P), Carbon (C), Nitrogen (N), Potassium (K) and Magnesium (Mg) and trace elements or micronutrients like Iron (Fe), Zinc (Zn) and Manganese (Mn) that can enrich soil and promote plant health.

Using fish scales not only reduces waste and pollution but also supports a circular economy by transforming discarded materials into valuable agricultural resources. By turning fish scales into biofertilizers, we can reduce waste, recycle valuable nutrients, and promote sustainable farming practices.

The aim of this study is to explore how fish scale-based biofertilizers can improve soil health, strengthen plants against environmental challenges, and reduce the negative impacts of conventional fertilizers on the environment. It focuses on the nutrient content of fish scales, how they break down in the soil, and their role in enriching it naturally. Using fish scales in this way can also contribute to reducing pollution and support the idea of a circular economy, where waste is transformed into useful products instead of being discarded.

Review of Literature and development in the subject:

(Previous work done in relevant area)

The Review of Literature highlights key research and findings in this area, focusing on fish scale-based biofertilizers, their application, benefits, and environmental significance.

Fish scales are a rich source of collagen, which breaks down into gelatin, providing essential amino acids like glycine and proline, which can improve soil structure and microbial health (Kumar et al., 2018). Gelatin also serves as a nutrient source for soil microorganisms, promoting their growth and activity (Ariani et al., 2020). Fish scales contain significant amounts of minerals, particularly calcium, which is vital for plant root development and helps improve soil pH and nutrient availability (Mehmood et al., 2022).

Fish scale-based biofertilizers contribute to soil organic matter (SOM), which is crucial for maintaining soil structure, water retention, and microbial activity (Tariq et al., 2021). By replacing chemical fertilizers with organic alternatives like fish scale-based biofertilizers, greenhouse gas emissions from the fertilizer production process can be reduced (Ghosh et al., 2020). This

approach aligns with circular economy principles, where waste products are repurposed into valuable resources (Soni et al., 2021). Research is needed to develop more efficient, low-cost methods for processing fish scale-based fertilizers (Wang et al., 2022). Research should focus on the optimal application rates, formulation methods, and long-term impacts on soil health (Vasanthi et al., 2021).

Objectives of the study:

1. To analyze the nutrient composition of freshwater fish scales.
2. To evaluate the effectiveness of fish scale-based biofertilizers in enhancing soil health.
3. To assess the impact on plant growth and yield.
4. To explore the role of fish scale-based biofertilizers in improving soil resilience.
5. To evaluate the environmental benefits of fish scale-based biofertilizers.
6. To develop guidelines for the sustainable use of fish scale-based biofertilizers.

Methodology to be adopted:

Study area:

The area of study for this research is Fish Markets such as Itwara Fish Market, Friday Fish Market, Taroda Fish Market from Nanded City Maharashtra.

Methods:

Collection and preparation of Fish Scales

- Source: Collect fish scales from local fish markets from Nanded City.
- Cleaning: Wash the scales thoroughly to remove impurities using tap water followed by deionized water.
- Drying: Using an oven at a low temperature (40–50°C) until they are fully dry.

- Grinding: Grind the dried fish scales into a fine powder using a grinder or blender.

Proximate Composition of Freshwater Fish Scales

Determination of Proximate components like Moisture, Proteins (Collagen), Lipids (Fats), Ash, Carbohydrates, Macronutrients like Calcium, Phosphorus, Nitrogen, Magnesium and Micronutrients like Potassium, Zinc, Iron, Manganese.

Preparation of Biofertilizer

- Enzyme: Protease (Bromelain)
- Enzyme Preparation: Extracted from Pineapple.

Procedure:

- Choose a ripe pineapple. Peel the pineapple, then cut the stem or core into small chunks.
- Place the stem or core pieces into a blender or food processor. Add a small amount of distilled water (about 1-2 cups).
- Blend the pieces into a smooth pulp, making sure it's well broken down to maximize the enzyme release.
- Once blended, strain the pulp through cheesecloth or a fine mesh strainer into a glass container or bowl.
- Collect the liquid portion, which contains the protease (Bromelain).
- Bromelain works best in a slightly acidic environment (pH 4.5-5.5). If the pH of your extract is too high, you can adjust it slightly using citric acid or lemon juice to bring it to the desired level.
- To preserve the protease activity, the extract should be kept cold.

Mix Fish Scales with Enzyme Solution

- Ratio: Mix the ground fish scales with the enzymatic solution. A general ratio can be 1 part fish scales to 5-10 parts water according to scale of production.
- Stir the mixture thoroughly to ensure the scales are evenly distributed in the solution.
- pH Adjustment: Check the pH of the solution. Enzymatic extraction often works best at a slightly acidic pH (around 4-6). If needed, the pH is adjusted by adding a small amount of diluted acid (e.g., citric acid) or base (e.g., sodium hydroxide) to optimize the enzyme activity.

Incubation for Enzymatic Breakdown

- Incubation Time: Incubate the mixture at a moderate temperature (around 30-40°C) for 24-48 hours.
- Monitor the Process: Check the progress every 12 hours to see if the scales are breaking down.

Strain the Extract

- After 24-48 hours of enzymatic treatment, strain the mixture through a muslin cloth to separate the liquid from the remaining solid fish scales.

Store the Biofertilizer

- Transfer the liquid biofertilizer to airtight containers and store it in a cool, dark place.

Preparation of Soil Samples

Procedure:

- Collect soil samples from different depths (0–15 cm and 15–30 cm).
- Collect about 500 g of soil from each location.
- **Drying:** Spread the soil thinly on a clean surface. Air dry at room temperature in a dust-free environment.
- **Grinding:** Use a mortar and pestle or soil grinder to crush large soil clumps. Sieve the soil using a 2 mm sieve for uniformity.
- **Storage:** Store the sieved soil in a clean, labelled container or zip-lock bag. Avoid moisture contamination.

Physico-Chemical Analysis Parameters:

- **Physical Properties:** Texture (sand, silt, clay percentage).
  Bulk density and porosity.
  Water-holding capacity.

- **Chemical Properties:** pH and electrical conductivity (EC).
  Organic carbon content.
  Macronutrients: Nitrogen (N), Phosphorus (P), Potassium (K).
  Micronutrients: Iron (Fe), Zinc (Zn), Manganese (Mn).

Application of Fish Scale Biofertilizer

- Treatment Setup:
  - Divide the soil into different groups: some with the biofertilizer, some without (control group).
  - Apply the fish scale biofertilizer to the experimental groups at the recommended amounts (either as soil addition or foliar spray).

Monitoring Soil Health Over Time

- Soil Properties:
  - Soil pH, Organic Matter, Nutrient Content, Microbial Activity

Plant Growth and Yield Assessment

- Plant Growth:
  - Germination Rate, Plant Height and Size, Root Development, Yield Evaluation

Long-Term Monitoring

- Repeat the study to see the effects of biofertilizer are sustained over time.
- Soil recovery to track soil properties.

Importance of Study/ Societal Application:

National Status

In India, biofertilizers play a crucial role in sustainable agriculture by enhancing soil fertility and crop productivity. They are widely used in organic farming and integrated nutrient management to reduce dependence on chemical fertilizers.

Popular biofertilizers include Rhizobium, Azotobacter, Azospirillum, and phosphate-solubilizing bacteria, which improve nitrogen fixation, phosphorus availability, and overall soil health. Biofertilizers also benefit smallholder farmers by lowering input costs and promoting eco-friendly farming practices, aligning with India's goals of food security and environmental sustainability.

Government programs like Paramparagat Krishi Vikas Yojana (PKVY), National Mission on Sustainable Agriculture (NMSA), Rashtriya Krishi Vikas Yojana (RKVY), Soil Health Management Scheme, National Project on Organic Farming (NPOF) encourage their adoption, especially among small and organic farmers. The biofertilizer market in India is growing steadily, driven by awareness of environmental benefits and support for organic certification.

International Status

Internationally, biofertilizers are gaining recognition as eco-friendly alternatives to chemical fertilizers, supporting sustainable agriculture and addressing global food security challenges. Countries like the USA, Brazil, and China are leading in their adoption, focusing on improving crop yield, soil health, and reducing greenhouse gas emissions. Biofertilizers like nitrogen-fixing bacteria, mycorrhizal fungi, and phosphorus-solubilizing microorganisms are widely applied in organic farming and precision agriculture.

Global initiatives, such as the FAO's support for sustainable soil management, emphasize biofertilizers in combating soil degradation and promoting regenerative farming. Their application aligns with international goals like the UN's Sustainable Development Goals (SDGs), particularly for environmental conservation and sustainable agriculture.

Freshwater fish scale-based biofertilizer enhances soil health, reduces synthetic fertilizer use, and supports sustainable agriculture. Nationally, it promotes waste management, industrial growth, and rural development, while internationally, it has export potential, generating foreign exchange and showcasing India’s commitment to eco-friendly innovations.

Significance of Study:

The present study will explore the potential of freshwater fish scales as a biofertilizer by analyzing their nutrient content, effectiveness in improving soil fertility, and role in promoting sustainable farming practices. It aims to enhance soil health, reduce environmental pollution, and support eco-friendly agricultural innovations.

Year wise work plan and targets to be achieved:

First Year: Introduction, Course work, Review of literature, Referencing, books and Methodology, Collecting samples from various fish markets from Nanded City.

Second Year: Determining the proximate components of fish scales, Soil Testing, Making the Biofertilizer in laboratory, Comparing the effectiveness of Biofertilizer with Normal soil, Noting the observations.

Third Year: Summery, Conclusion, Bibliography, Documentation, Analysis of result, Writing, Typing and Submission of thesis.

Expected Outcomes:

- The research will provide innovative insights into utilizing freshwater fish scales as an eco-friendly biofertilizer, offering a sustainable solution for agricultural practices.

- It will contribute valuable data to guide government policies on waste management and sustainable agriculture, potentially boosting revenue through industrial applications and exports.

- The study will serve as a resource for researchers and students by enriching the literature on biofertilizers and sustainable farming.

- The findings could highlight environmental and health benefits, reducing reliance on chemical fertilizers and promoting eco-conscious practices for improved human well-being.

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